

**Notice of Allowability**

Application No.

09/872,810

Examiner

ANH H DO

Applicant(s)

AMMICH T ET AL.

Art Unit

2624

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☐ This communication is responsive to \_\_\_\_.
2. ☒ The allowed claim(s) is/are 1-18.
3. ☒ The drawings filed on 04 June 2001 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some\* c) ☐ None of the:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

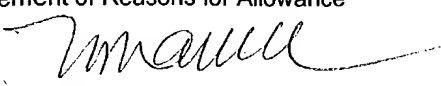
\* Certified copies not received: \_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.  
(a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached  
1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_.  
(b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08),  
Paper No./Mail Date \_\_\_\_
4. ☐ Examiner's Comment Regarding Requirement for Deposit  
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413),  
Paper No./Mail Date \_\_\_\_
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other \_\_\_\_

  
ANH H DO  
Primary Examiner  
Art Unit: 2624

### DETAILED ACTION

1. Claims 1-18 are allowed.
2. The following is an examiner's statement of reasons for allowance:

The present invention provides a new Wavelet transform process which comprises a generalization of set partitioning in hierarchical tree for image compression that is less complex computationally and requires less memory overhead (see specification, page 1, paragraph 2).

In particular, the prior art, taken either singly or in combination, does not teach:

- as the wavelet transform coefficients are obtained, counting for each bit-planes the bits of: node  $v$ ;  $B1(v)$  bits representing the magnitude of the wavelet transform coefficients associated with all descendents of the node  $v$ ; and  $B2(v)$  bits representing the magnitude of the wavelet transform coefficients associated with all grandchildren and their descendents of the node  $v$ ; accumulating said bit-counts during computing of said wavelet transform; emitting all bits produced by said node as soon as said node is processed; and stopping the production of unneeded bits upon reaching a stopping criterion (see independent claim 1);
- determining the highest bit-plane in which any direct descendent of said node  $v$  has non-zero bit and the highest bit-plane in which any indirect descendent of node  $v$  has non-zero bit; and determining the highest the bit-plane  $B(v)$  in which the coefficient  $v$  of said node  $v$  has non-zero bit; and within a fixed bit-budget

Art Unit: 2624

allocated among said bit-planes, emitting the bits generated into output queue (see independent claim 18).

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."


### ***Contact Information***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANH H DO whose telephone number is 703-308-6720. The examiner can normally be reached on 5/4-9.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, DAVID K MOORE can be reached on 703-308-7452. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

November 29, 2004.

  
ANH HONG DO  
PRIMARY EXAMINER

CLAIMS

~~Claim~~ 1. In a Wavelet transform process for compressing digital data representative of an object, a method for accelerating the encoding of bits, comprising the steps of:

performing a Wavelet transform on said digital data thus forming hierarchical tree data, each node of each tree in said tree data containing Wavelet transform coefficients and associated parameters, each tree having a root node  $v$ , the bits for every said tree being contained in bit\_planes;

as said Wavelet transform coefficients are obtained, counting for each said bit-plane the bits of: said node  $v$ ;  $B_1(v)$  bits representing the magnitude of the Wavelet transform coefficients associated with all descendents of a said node  $v$ ; and  $B_2(v)$  bits representing the magnitude of the Wavelet transform coefficients associated with all grandchildren and their descendents of said node  $v$ ;

accumulating said bit-counts during computing of said Wavelet transform;

emitting all bits produced by said node as soon as said node is processed; and

stopping the production of unneeded bits upon reaching a stopping criterion,

~~Claim~~ 2. The method of claim 1, wherein said stopping step further comprises setting a bit-budget allocated among said bit-

3 planes, said budget fixing the maximum number of bits allowed to be  
4 emitted from said coefficients at each said node during processing.

AD 1 ~~Claim~~ 3. The method of claim 1, comprising the further steps of:  
2 maintaining a bit-counter for each said bit-plane;  
3 summing the total number of bits produced in each said bit-  
4 plane to determine within a fixed bit\_budget the exact number of  
5 bits emitted in the last plane examined; and  
6 stopping said bit summing at said point.

09872810-060401 1 AD ~~Claim~~ 4. The method of claim 2, wherein the number of bits emitted  
2 by a said node in a given said bit-plane includes a value bit for bit-  
3 planes  $b$  such that  $B_1(p) \geq b$  where  $p$  is a parent node.

1 AD ~~Claim~~ 5. The method of claim 4, wherein the number of bits emitted  
2 by a said node in a given said bit-plane includes a signum bit for bit-  
3 planes  $b$  of  $b = B(v)$ .

1 AD ~~Claim~~ 6. The method of claim 5, wherein the number of bits emitted  
2 by a said node in a given said bit-plane includes emitting a  $B_1$  bit for  
3  $B_2(p) \geq b \geq B_1(v)$ .

1 AD ~~Claim~~ 7. The method of claim 6, wherein the number of bits emitted  
2 by a said node in a given said bit-plane includes emitting a  $B_2$  bit for  
3  $B_1(v) \geq b \geq B_2(v)$ .

1 ~~AD~~ Claim 8. The method of claim 7, further comprising the step of  
2 maintaining separate output queues in accordance with predetermined  
3 criteria.

1 ~~AD~~ Claim 9. The method of claim 1, comprising the further step of  
2 designating subtrees in said tree corresponding to sub-parts of said  
3 object.

1 ~~AD~~ Claim-10. The method of claim 7, further comprising the steps of:  
2 providing a plurality of accumulators corresponding to the  
3 number of said bit-planes being processed, sequenced from the most  
4 significant to the least significant bit-plane; and  
5 incrementing each said accumulator as each said Wavelet  
6 coefficient is stored by the number of bits that said coefficient will  
7 contribute to the corresponding said bit-plane.

1 ~~AD~~ Claim 11. The method of claim 1, comprising the further step of  
2 extracting only bits from higher planes for the remaining trees after  
3 said bit-budget is reached for a given tree.

1 ~~AD~~ Claim-12. The method of claim 7, comprising the further steps of:  
2 instructing said nodes to emit bits from said bit-planes up  
3 to and including an ending bit-plane, until a predetermined said bit-  
4 budget allocated to said ending bit-plane is reached; and  
5 forming said bits emitted from said ending bit-plane in  
6 three queues, the first said queue receiving bits comprising the node  
7 bits for  $b > B(v)$ ; the second said queue receiving  $b = B(v)$  bits, said

090223-010401

8 signum bits, and said  $B_1$  and  $B_2$  bits; and the third said queue  
9 receiving remaining node value bits.

AD

1 Claim-13. The method of claim 1, wherein said emitting  
2 step comprises the further steps of:

3 instructing an active node to describe its own coefficients and  
4 emit bits subject to a bit-dropping criterion;

5 determining whether any node below said active node is large  
6 enough to continue traversal based on a node selection criterion and a  
7 stopping criterion; and

8 returning to said traversal algorithm if said determination is  
9 negative.

AD

1 Claim 14. The method of claim 13, comprising the further step of:

2 activating, as determined by a tree traversal criterion and a  
3 node selection criterion, all children of said active node when said  
4 determination is affirmative; and

5 subject to a bit emission stopping criterion, instructing said  
6 children nodes to describe their coefficients and to emit all relevant  
7 bits in turn.

AD

1 Claim-15. The method of claim 14, comprising the further step of  
2 computing concurrently the bits of plural ones of selected said  
3 nodes.

AD

1 Claim 16. The method of claim 15, wherein said process further  
2 comprises the step of receiving and decoding said encoding bits.

TOP SECRET

1 ~~AD~~ Claim 17. The method of claim 16, comprising the further step of  
2 changing the order of traversal between encoding and decoding of  
3 said bits.

1 ~~AD~~ Claim 18. In a Wavelet transform process for compressing digital  
2 data representative of an object, the improvement comprising:  
3 performing a sub-band decomposition of said digital data into  
4 hierarchical tree data of Wavelet transform coefficients;  
5 traversing the subtrees associated with each tree node  $v$ ;  
6 in the course of said traversing,  
7 determining the highest bit-plane in which any direct  
8 descendant of said node  $v$  has a non-zero bit and the highest  
9 bit-plane in which any indirect descendant of node  $v$  has a non-  
10 zero bit; and  
11 determining the highest the bit-plane  $B(v)$  in which the  
12 coefficient  $v$  of said node  $v$  has a non-zero bit;  
13 and  
14 within a fixed bit-budget allocated among said bit-planes,  
15 emitting the bits generated into an output queue.

09872810-050401